The Potential of Coconut Oil and its Derivatives as Effective and Safe Antiviral Agents Against the Novel Coronavirus (nCoV-2019)

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As we write this, the World Health Organization has declared a global emergency over the novel coronavirus, nCoV-2019, that has spread beyond China. There is still no cure for nCoV-2019. nCoV-2019 has been shown to be related to SARS (Zhou *et al.*, 2020), a coronavirus which caused an outbreak in 2003. Several researchers have been designing drugs to specifically target protease enzymes in coronavirus, but testing for these drugs is many months away. What if there is a treatment candidate against the coronavirus that might already be available and whose safety is already established? Lauric acid (C12) and monolaurin, its derivative, have been known for many years to have significant antiviral activity. Lauric acid is a medium-chain fatty acid which makes up about 50% of coconut oil; monolaurin is a metabolite that is naturally produced by the body's own enzymes upon ingestion of coconut oil and is also available in pure form as a supplement. Sodium lauryl sulfate, a common surfactant that is made from lauric acid, has been shown to have potent antiviral properties. Lauric acid, monolaurin, and sodium lauryl sulfate (which is also known as sodium dodecyl sulfate) are used in a wide range of products for their antiviral properties.

Mechanisms of action

Three mechanisms have been proposed to explain the antiviral activity of lauric acid and monolaurin: first, they cause disintegration of the virus envelope; second, they can inhibit late maturation stage in the virus replicative cycle; and third, they can prevent the binding of viral proteins to the host cell membrane.

1. Disintegration of the virus membrane. The antiviral activities of lauric acid and monolaurin were first noted by Sands and co-workers (1979) and later by Hierholzer & Kabara (1982). In particular, Hierholzer & Kabara showed that monolaurin was able to reduce infectivity of 14 human RNA and DNA enveloped viruses in cell culture by >99.9%, and that monolaurin acted by disintegrating the virus envelope. Thormar and co-workers (1987) confirmed the ability of lauric acid and monolaurin to inactivate viruses by disintegration of the cell membrane. Sodium lauryl sulfate has been shown to be able to solubilize and denature the viral envelope (Piret 2000, 2002).

2. Inhibits virus maturation. The Junin virus (JUNV) is the causative agent of Argentine hemorrhagic fever. In a comparison among the saturated fatty acids from C10 to C18 against JUNV infection, Bartolotta and co-workers (2001) showed that lauric acid was the most active inhibitor. From mechanistic studies, it was concluded that lauric acid inhibited a late 2 maturation stage in the replicative cycle of JUNV. From transmission electron microscope images, JUNV is an enveloped virus featuring glycoproteins that are embedded in the lipid bilayer forming viral spikes (Grant *et al.*, 2012); this is similar to nCoV-2019.

3. Prevents binding of viral proteins to the host cell membrane. Hornung and co-workers (1994) showed that in the presence of lauric acid, the production of infectious vesicular stomatitis virus was inhibited in a dose-dependent and reversible manner: after removal of lauric acid, the antiviral effect disappeared. They observed that lauric acid did not influence viral membrane (M) protein synthesis, but prevented the binding of viral M proteins to the host cell membrane.

Although lauric acid accounts for much of the reported antiviral activity of coconut oil, capric acid

(C10) and monocaprin have also shown promising activity against other viruses, such as HIV-1

(Kristmundsdóttir *et al.*, 1999). Capric acid accounts for about 7% of coconut oil. Thus, at least two fatty acids in coconut oil, and their monoglycerides, have antiviral properties. Hilarsson and co-workers (2007) tested virucidal activities of fatty acids, monoglycerides and fatty alcohols against respiratory syncytial virus (RSV) and human parainfluenza virus type 2 (HPIV2) at different concentrations, times and pH levels. They reported

the most active compound tested was monocaprin (C10), which also showed activity against influenza A virus and significant virucidal activities even at a concentration as low as 0.06-0.12%. Use of coconut oil and C12 derivatives in animals and humans

Coconut oil and its derivatives have been shown to be safe and effective antiviral compounds in both humans and animals. Because of the antiviral and antibacterial protection that it provides to animals, coconut oil, as well as lauric acid and monolaurin, is used in farm animals and pets as veterinary feed supplements in chicken, swine and dogs (Baltic et al., 2017). Monolaurin has been shown to effectively protect chicken against avian influenza virus (van der Sluis, 2015). Li and coworkers (2009) prepared a gel containing monolaurin and is found to be highly active against repeated high viral loads of Simean immunodeficiency virus in macaques and Kirtane and coworkers (2017) developed a 35% gel of monolaurin for application in the female genital tract to protect against HIV. Sodium lauryl sulfate (SLS) has been used at low concentrations to inactivate viruses in milk of farm animals (de Sousa et al., 2019). SLS is the active constituent in commercial disinfecting wipes and standard laboratory disinfectants, and is an emulsifying agent and penetration enhancer in pharmaceutical preparations.

Coconut oil itself has been shown to have anti-HIV properties in small clinical studies. The first clinical trial using coconut oil (45 mL daily) and monolaurin (95% purity, 800 mg daily) against HIV-AIDS was conducted in the Philippines. This study involved 15 HIV patients, aged 22 to 38 years, 5 males and 10 females, for 6 months. There was only one fatality and 11 of the patients showed higher CD4 and CD8 counts after 6 months (*Dayrit, 2000*).

In another study, 40 HIV subjects with CD4+ T lymphocyte counts less than 200 cells/microliter were divided into a virgin coconut oil (VCO) group (45 mL daily) and control group (no VCO). After 6 weeks, the VCO group showed significantly higher average CD4+ T lymphocyte counts versus control (Widhiarta, 2016).

Conclusion

Several in vitro, animal, and human studies support the potential of coconut oil, lauric acid and its derivatives as effective and safe agents against a virus like nCoV-2019. Mechanistic studies on other viruses show that at least three mechanisms may be operating. Given the considerable scientific evidence for the antiviral activity of coconut oil, lauric acid and its derivatives and their general safety, and the absence of a cure for nCoV-2019, we urge that clinical studies be conducted among patients who have been infected with nCoV-2019 (see below). This treatment is affordable and virtually risk-free, and the potential benefits are enormous. On the other hand, given the safety and broad availability of virgin coconut oil (VCO), we recommend that VCO be considered as a general prophylactic against viral and microbial infection.

A proposed clinical study

We can propose that a clinical study be conducted on patients infected with nCoV-2019 accordingly:

- Group 1: Control group, standard care
- Group 2: standard care + VCO (45 mL, approx. 3 three tablespoons, daily or higher,)
- Group 3: standard care + Monolaurin (95% purity, 800 mg daily). Monolaurin is recognized as GRAS by US FDA.
- Group 4: standard care + Monocaprin (95% purity, 800 mg daily). Monocaprin is recognized as GRAS by US FDA.
- Group 5: standard care + SLS (pharmaceutical grade, 100 mg/kg/day). SLS toxicity: lowest NOAEL (repeated dose, rat): 100 mg/kg/day (hepatotoxicity) (Bondi *et al.*, 2015). ■

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Scientists study efficacy of coconut oil in COVID-19 treatment

Dhel Nazario

A study on whether certain coconut oil components can diminish or prevent the infectivity of SARS-CoV-2, the causative virus of coronavirus disease (COVID-19), is now underway as well as another project that that will aid in the monitoring and management of the infection.

In partnership with the Ateneo De Manila University (ADMU) and the Duke-National University of Singapore (Duke-NUS), the project will focus first on the determination of the anti-viral properties of the compounds and the results will be used for further studies.

The Department of Science and Technology – Philippine Council for Health Research and Development (DOST-PCHRD) supports this as well as other research and development of technologies and projects, after recognizing the risks posed by COVID-19 towards public health.

Faster application

In partnership with the Department of Health (DOH) and DOST-PCHRD, ADMU developed the Feasibility Analysis of Syndromic Surveillance Using Spatio-Temporal Epidemiological Modeler (FASSSTER) for Early Detection of Diseases application for visualizing the spread of diseases, using data from the Philippine Integrated Disease Surveillance and Response (PIDSR) system, Electronic Medical Records, and SMS-based reports of primary care facilities.

At present, it is used to create predictive models and visualize possible scenarios of outbreaks of dengue fever, typhoid fever, and measles at specified time periods. The research team will enhance the system for use in COVID-19 surveillance and response, as it will help support the planning and decision-making of the Department of Health (DOH), local government units, and healthcare facilities.

Transmission pattern

Meanwhile, the Research Institute for Tropical Medicine (RITM) will be conducting a study that aims to determine the transmission patterns of COVID-19 to help prevent its further spread and support the DOH in crafting policies for the containment and prevention of COVID-19.

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